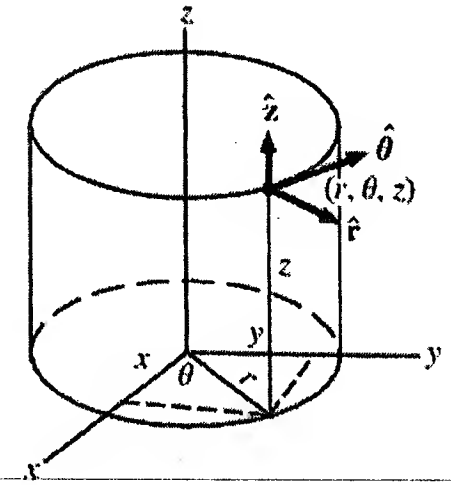
Exhibit A

Cylindrical Coordinates Examples

Cylindrical Coordinates

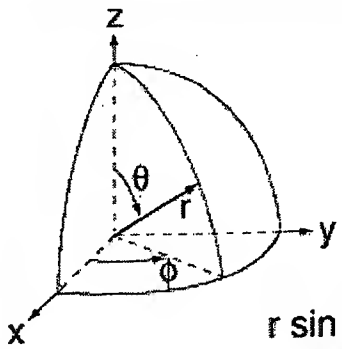


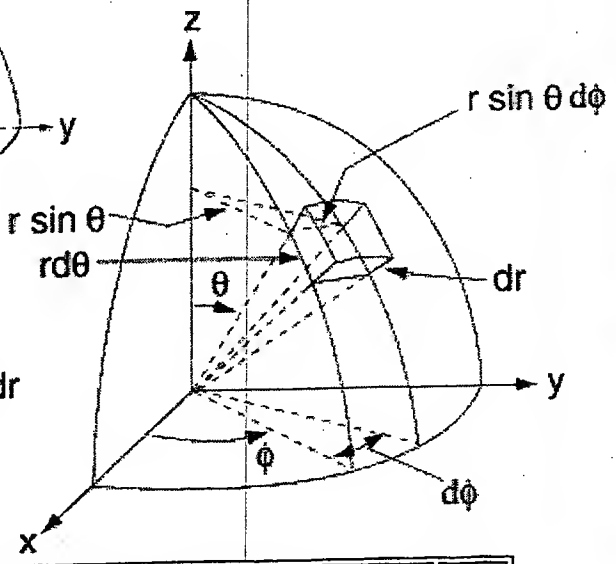
Cylindrical coordinates are a generalization of two-dimensional polar coordinates to three dimensions by superposing a height (z) axis. Unfortunately, there are a number of different notations used for the other two coordinates. Either r or ρ is used to refer to the radial coordinate and either ϕ or θ to the azimuthal coordinates. Arfken (1985), for instance, uses (ρ, ϕ, z), while Beyer (1987) uses (r, θ, z). In this work, the notation (r, θ, z) is used.

The following table summarizes notational conventions used by a number of authors.

(radial, azimuthal, vertical)	reference
(r, θ, z)	this work, Beyer (1987, p. 212)

Spherical Polar Coordinates





Volume element

$dV = r^2 \sin\theta \, d\theta \, d\phi \, dr$

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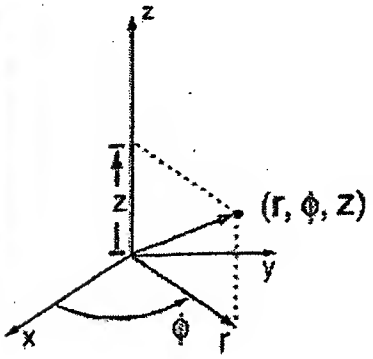

With the axis of the circular cylinder taken as the z-axis, the perpendicular distance from the cylinder axis is designated by r and the azimuthal angle taken to be ϕ.

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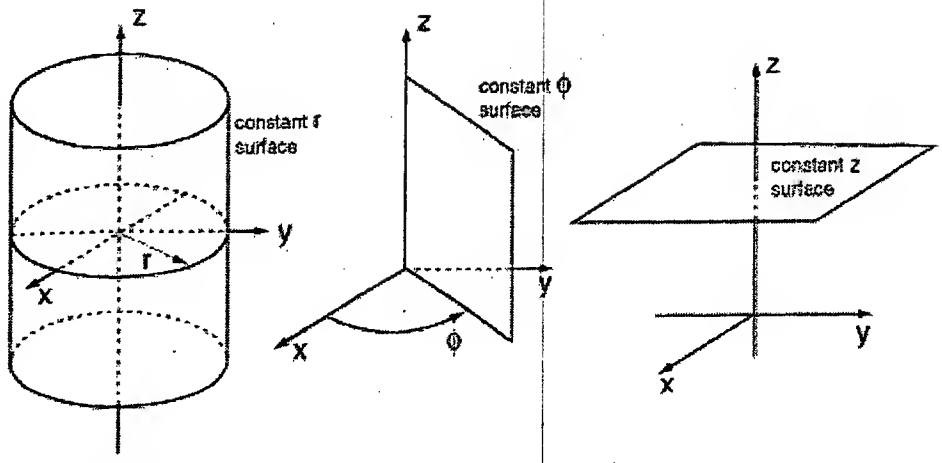

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Applications of Spherical Polar Coordinates

Physical systems which have spherical symmetry are often most conveniently treated by using spherical polar coordinates.

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